PULS

MLY02.100

MiniLine **MLY-Series** DC12-48V (120V), 10A, DUAL REDUNDANCY MODULE

REDUNDANCY MODULE

- Cost Effective Solution to Build Redundant Systems
- Dual Input with Single Output
- Two Diodes (Common Cathode)
- DC12-48V (120Vdc) ±25% Wide-range Input
- Full Power Between -40°C and +60°C
- Compact Design, Width only 45mm
- Quick-connect Spring-clamp Terminals
- Easy Wiring:
  Distribution Terminal for Negative Pole Included
- 3 Year Warranty

PRODUCT DESCRIPTION

The MLY02.100 is a simple is a redundancy module, which can be used to build 1+1 and N+1 redundant system. It is equipped with two input channels, which can be connected to power supplies with up to 5A output current and one output, which can carry nominal currents up to 10A. The module is suitable for power supplies with constant current overload behavior as well as any kind of "Hiccup" overload behavior.

Unique quick-connect spring-clamp terminals allow a safe and fast installation and a large international approval package for a variety of applications makes this unit suitable for nearly every situation.

SHORT-FORM DATA

Input voltage	DC 12-48V ±25% DC 12-120V ±25%	w/o restrictions with restrictions
Input voltage range	9-60Vdc 9-150Vdc	w/o restrictions with restrictions
Input current	2x 0-5A 2x 0-8A	continuous for 5 seconds
Output current	0-10A 10-16A <16A	continuous for 5 seconds at cont. overload/ short circuit
Input to output voltage drop	typ. 0.8V typ. 0.9V typ. 0.9V	input: 2x2.5A input: 1x5A input: 2x5A
Power losses	typ. 0W typ. 4.0W typ. 4.5W typ. 9.0W	at no load input: 2x2.5A input: 1x5A input: 2x5A
Temperature range Derating	-40°C to +70°C 0.25A/°C	operational, +60 to +70°C
Dimensions	45x75x91mm	WxHxD
Weight	140g / 0.31lb	

ORDER NUMBERS

Redundancy Module	**MLY02.100**

MAIN APPROVALS

For details and the complete approval list, see chapter 13.

UL 508 | UL 60950-1 | ATEX

IECEx | Marine | Marine

INDEX

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.

Earth, Ground This document uses the term "earth" which is the same as the U.S. term "ground".

t.b.d. To be defined, value or description will follow later.

DC 24V A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included.
E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)

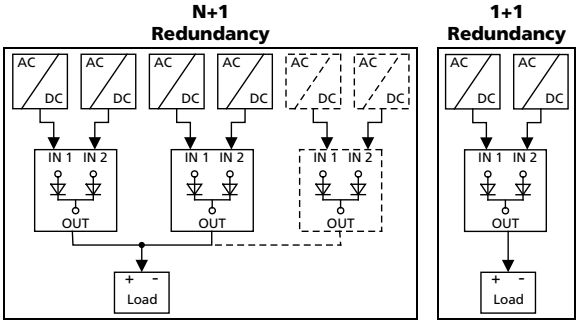
24Vdc A figure with the unit (Vdc) at the end is a momentary figure without any additional tolerances included.

may A key word indicate flexibility of choice with no implied preference

shall A key word indicate a mandatory requirement

should A key word indicate flexibility of choice with a strongly preferred implementation

1+1 Redundancy Use of two identical power supplies in parallel to provide continued operation following most failures in a single power supply. The two power supply outputs should be isolated from each other by utilizing diodes or the switching arrangements.
E.g. two 2.5A power supplies are needed to achieve a 2.5A redundant system.



N+1 Redundancy Use of three or more identical power supplies in parallel to provide continued operation following most failures in a single power supply. All power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g.: To achieve a 10A redundant system, five 2.5A power supplies are needed in a N+1 redundant system.

1. INTENDED USE

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, process control, monitoring and measurement equipment or the like. Do not use this device in equipment where malfunction may cause severe personal injury or threaten human life.

The redundancy module can be used with any type of power supply as long as the maximum output current ratings are not exceeded. It is suitable for power supplies with continuous overload current as well as any kind of intermittent (Hiccup) overload behavior.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

2. INSTALLATION INSTRUCTIONS

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Turn power off before working on the device and protect against inadvertent re-powering.
- Do not open, modify or repair the device.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Obey the following installation instructions:

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install the device in an enclosure providing protection against electrical, mechanical and fire hazards.

Do not ground or earth the positive output pole which could prevent redundancy in case of a ground failure. Ground the negative output pole, when needed.

Use only power supplies with a negligible output ripple voltage in the low frequency range between 50Hz and 10kHz when used in marine applications according to the GL regulations.

Install the device onto a DIN rail according to EN 60715 with the input terminals on the top of the device. Other mounting orientations require a reduction in output current.

Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60°C for ambient temperatures up to +45°C, 75°C for ambient temperatures up to +60°C and 90°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The enclosure of the device provides a degree of protection of IP20. The enclosure does not provide protection against spilled liquids.

The input must be powered from a PELV or SELV source or an “Isolated Secondary Circuit” in order to maintain a SELV or PELV output.

Check correct input polarity. The device will not operate when input voltage is reversed.

The device is designed as “Class of Protection III” equipment according to IEC 61140.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid!

The device is designed for altitudes up to 5000m (16400ft). Above 2000m (6560ft) a reduction in output current is required.

Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 5mm left and right side. Increase the 5mm to 15mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5mm can be reduced to zero.

The maximum surrounding air temperature is +70°C (+158°F). The operational temperature is the same as the ambient or surrounding air temperature and is defined 2cm below the device.

The device is designed to operate in areas between 5% and 95% relative humidity.

Installation Instructions for Hazardous Location Areas

The device is suitable for use in Class I Division 2 Groups A, B, C, D locations and for use in Group II Category 3 (Zone 2) environments.

Hazardous Location classification: ATEX: EPS 11 ATEX 1 312 X, II 3G EX ec IIC T4 Gc

⚠ WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment.

Do not disconnect the device unless power has been switched off or the area is known to be non-hazardous.

A suitable enclosure must be provided for the end product which has a minimum protection of IP54 and fulfils the requirements of the EN 60079-0.

3. INPUT AND OUTPUT CHARACTERISTICS

Number of inputs		2	
Number of outputs		1	
Input voltage	nom.	DC 12-48V ±25%	The input circuitry must meet the SELV requirements stipulated by IEC/EN/UL 60950-1.
Input voltage range		9–60Vdc	
Input voltage with restrictions	nom.	DC 12-120V ±25%	See note 3 on bottom of the table
Input voltage range with restrictions		9-150Vdc	Restrictions apply, see note 3 on bottom of the table.
Voltage drop, input to output	typ.	0.8V	at 2x2.5A, see Fig. 3-2
	typ.	0.9V	at 1x5A, see Fig. 3-3
	typ.	0.9V	at 2x5A, see Fig. 3-2
Input current	nom.	2x 0-5A	continuous
	nom.	1x 0-10A	continuous, see note 1
	nom.	2x 5-8A	for 5 seconds
Peak input current	max.	125A	for maximal 10ms per input
Output current	nom.	10A	continuous
	nom.	10-16A	for 5 seconds
	max.	16A	at continuous overload or short circuit, see note 2
Reverse current	max.	0.6mA	per input, -40°C to +60°C
Reverse voltage	max.	200Vdc	voltage applied to the output, continuously allowed

Note 1: Each input can be loaded up to 10A. At currents above 10A, the other input should not be loaded. It is preferable to parallel the two inputs in order to minimize the power loss in such cases.

Note 2: Ensure that the continuous output current does not exceed 16A. Check the short-circuit current of the power sources and if the power source can deliver more than 16A together, use an appropriate fuse on the output.

Note 3: The redundancy module can be used with input voltages up to 150Vdc with the constraint, that it can be used only as a single input module at voltages above 60Vdc. Both inputs need to be connected together as shown in Fig. 3-1. Ensure proper means to protect against touching this voltage.

Fig. 3-1 **Restrictions for utilizing voltages between 60 and 150Vdc (See also Note 3)**

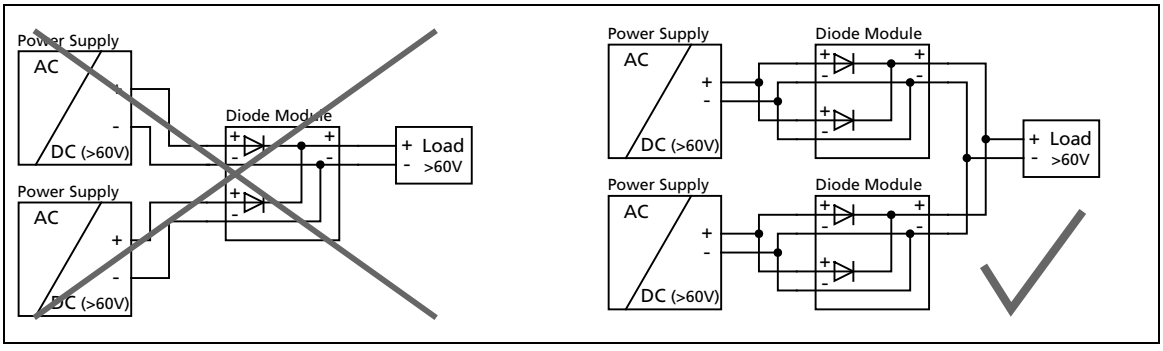


Fig. 3-2 **Input to output voltage drop when both inputs draw current**
(typical 1+1 redundant case, when the output voltages of the two units are equal or set into "parallel use" mode)

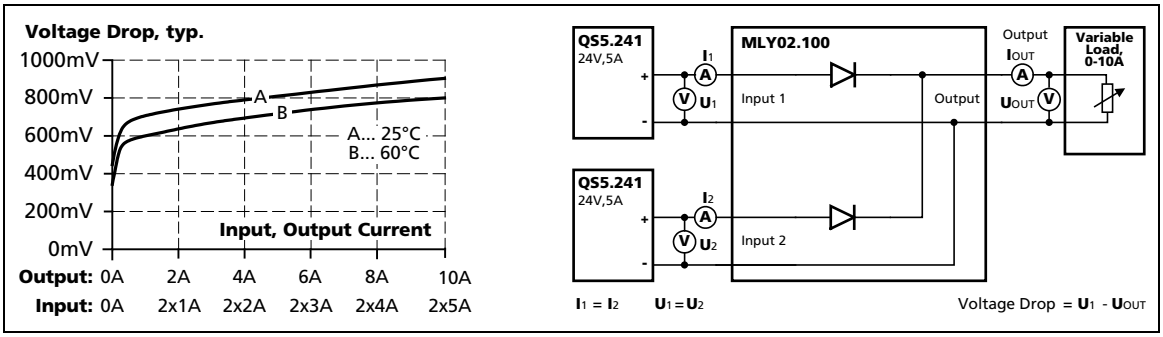
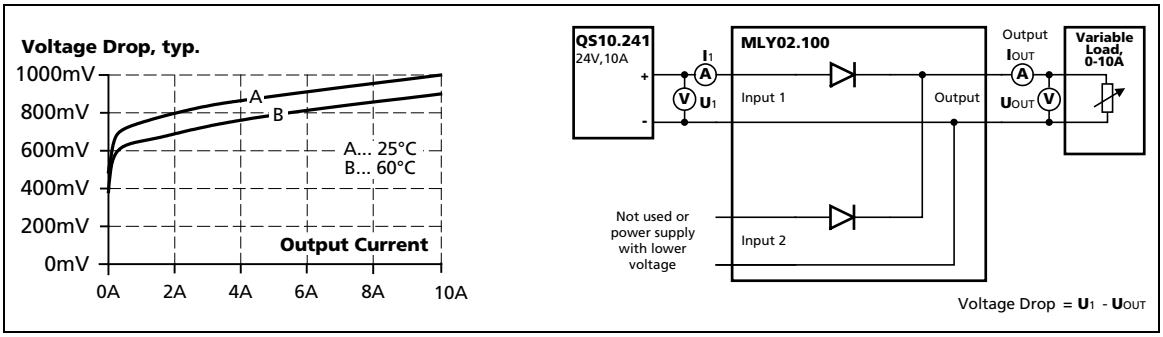


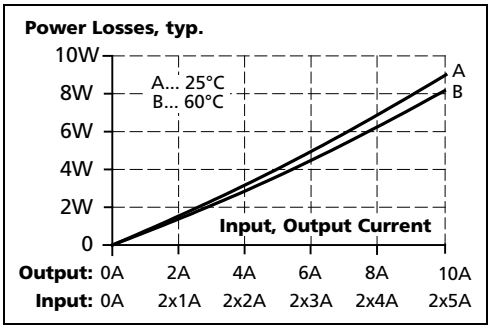
Fig. 3-3 **Input to output voltage drop when only one input draws current**



4. POWER LOSSES

		DC 24V	
Power losses	typ.	4.0W	input: 2x2.5A
	typ.	4.5W	input: 1x5A
	typ.	9.0W	input: 2x5A
Standby power losses	typ.	0W	at no output current

Fig. 4-1 **Power losses**



5. LIFETIME EXPECTANCY AND MTBF

The redundancy module has two input channels which are completely independent from each other. Each control circuit, auxiliary voltage source, or other circuitry in the module are designed separately for each input. The dual input redundancy module can be considered as two single redundancy modules combined together in one housing. The only common point is the circuit trace that ties the two separate circuits together at the output.

The MTBF figures below are for the entire dual input module. If the MTBF number of only one path is needed, simply double the value from the table.

The redundancy module does not have electrolytic capacitors included. Therefore, the lifetime expectancy is extremely high.

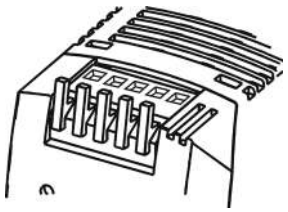
Input / output current conditions		**Input: 2x5A Output: 10A**	
Lifetime expectancy *)	min.	25 years	at 24V and 40°C
	min.	25 years	at 24V and 25°C
MTBF **) SN 29500, IEC 61709		84 868 000h	at 24V 40°C
		125 266 000h	at 24V 25°C
MTBF **) MIL HDBK 217F		71 454 000h	at 24Vand 40°C (Ground Benign GB40)
		81 453 000h	at 24Vand 25°C (Ground Benign GB25)

*) The **Lifetime expectancy** shown in the table indicates the minimum operating hours (service life).

) **MTBF stands for **M**ean **T**ime **B**etween **F**ailure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.
The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

6. TERMINALS AND WIRING

	Input and output
Type	Bi-stable, quick-connect spring clamp terminals. IP20 Finger safe construction. Suitable for field- and factory installation.
Solid wire	0.3-4mm²
Stranded wire	0.3-2.5mm²
American Wire Gauge	26-12 AWG
Max. wire diameter	2.8mm (including ferrule)
Wire stripping length	6mm / 0.25inch
Pull-out force	10AWG:80N, 12AWG:60N, 14AWG:50N, 16AWG:40N (according to UL486E)

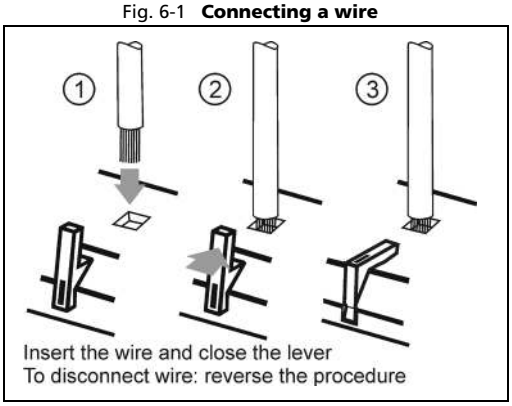


Terminals shipped in open position.

Instructions:

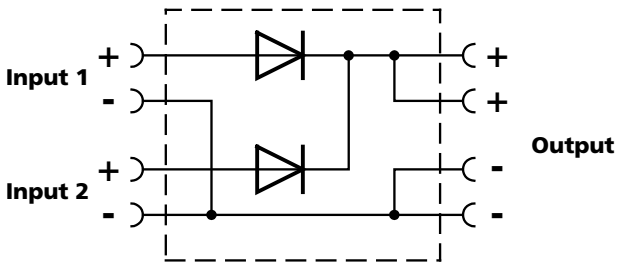
a) Use appropriate copper cables that are designed for minimum operating temperatures of:
60°C for ambient up to 45°C and
75°C for ambient up to 60°C and
90°C for ambient up to 70°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Ferrules are allowed, but not required.
e) Do not connect or disconnect the wires from the terminals below -25°C (-13°F).

Fig. 6-1 **Connecting a wire**



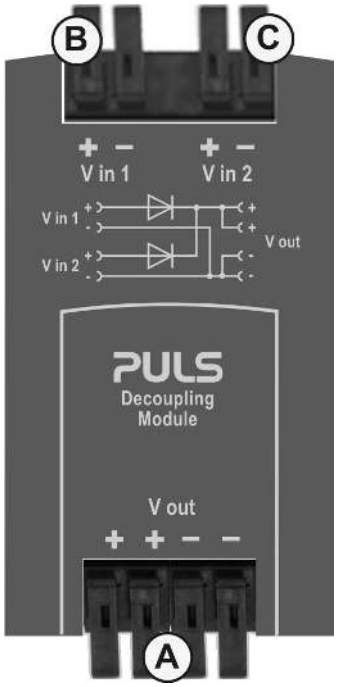
7. FUNCTIONAL DIAGRAM

Fig. 7-1 **Functional diagram**



8. FRONT SIDE AND USER ELEMENTS

Fig. 8-1 **Front side**



A **Output terminal**

B **Input terminals for input 1**

C **Input terminals for input 2**

9. EMC

The redundancy module is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions. A detailed EMC report is available on request.

EMC Immunity	According generic standards: EN 61000-6-1 and EN 61000-6-2			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 15kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	10V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	2kV 2kV	Criterion A Criterion A
Surge voltage on input lines	EN 61000-4-5	+ / - → DIN rail	1kV	Criterion A
Surge voltage on output line	EN 61000-4-5	+ / - → DIN rail	1kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	10V	Criterion A
Power-frequency magnetic field *)	EN 61000-4-8	50Hz	30A/m	Criterion A

Criterions:

A: Redundancy module shows normal operation behavior within the defined limits.

Notes:

***)** A test is not applicable according to EN 61000-6-2, since the device does not contain components susceptible to magnetic fields, e.g. hall elements, electrodynamic microphones, etc.

EMC Emission	According generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Class B, input lines *)
	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Class B, output lines *)
Radiated emission	EN 55011, EN 55032	Class B

This device complies with FCC Part 15 rules.
Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

*) Provided, that power sources connected on the inputs fulfill the class B requirements too.

10. ENVIRONMENT

Operational temperature *)	-40°C to +70°C (-40°F to 158°F)	Reduce output power above +60°C
Output de-rating	0.25A/°C	60-70°C (140°F to 158°F), see
Storage temperature	-40 to +85°C (-40°F to 185°F)	for storage and transportation
Humidity **)	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal ***)	2-17.8Hz: ±1.6mm 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock ***)	15g 6ms, 10g 11ms 3 bumps / direction 18 bumps in total	IEC 60068-2-27
Altitude	0 to 2000m (0 to 6560ft)	without any restrictions
	2000 to 6000m (6560 to 20000ft)	reduce output power or ambient temperature, see Fig. 10-2
Altitude derating	0.7A/1000m or 5°C/1000m	> 2000m (6500ft), see Fig. 10-2
Over-voltage category	not applicable	The concept of the overvoltage category is used for equipment energized directly from the low voltage mains (IEC 60664-1 §4.3.3.2.1).
Degree of pollution	2	IEC 62103, EN 50178, not conductive

*) Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.

**) Do not energize while condensation is present

***) Tested in combination with DIN rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting orientation.

Fig. 10-1 **Output current vs. ambient temp.**

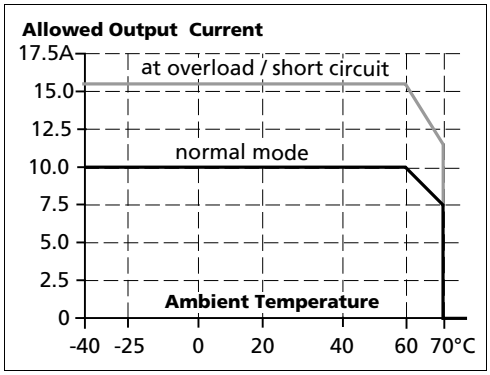
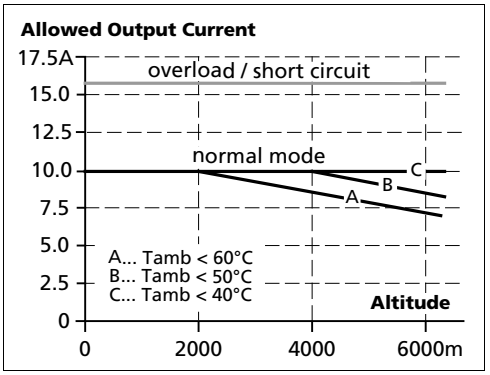


Fig. 10-2 **Output current vs. altitude**



11. PROTECTION FEATURES

Output over-current protection	not included	
Reverse input polarity protection	included	unit does not start when input voltage is reversed
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	> 2.5mm	e.g. screws, small parts
Over-temperature protection	not included	
Input transient protection	not included	
Output transient protection	not included	
Internal input fuse	not included	

12. SAFETY FEATURES

Input / output separation	no galvanic separation	200V epitaxial diode between input and output
Safety level of output voltage	The output voltage is regarded to be SELV (EN 60950-1) or PELV (EN 60204-1, EN 50178, IEC 60364-4-41) if the input voltage fulfils the requirements for a SELV source or PELV source.	
Class of protection	III	plastic housing, PE connection not required

13. APPROVED, FULFILLED OR TESTED STANDARDS

UL 508	c UL US LISTED	UL Certificate Listed equipment for category NMTR - Industrial Control Equipment Applicable for US and Canada E-File: E198865
IEC 60950-1	CB Report	CB Scheme Certificate General safety requirements for Information Technology Equipment (ITE)
UL 60950-1	c UL us	UL Certificate Recognized component for category QQGQ - Information Technology Equipment (ITE) Applicable for US and Canada E-File: E137006
ATEX	Ex	Agency Certificate (Bureau Veritas) EN 60079-0 Explosive atmospheres - General requirements EN 60079-7 Equipment protection by type of protection "e" Certificate: EPS 11 ATEX 1 312 X Temperature Code: T4 Type of Protection: ec
IECEx	IECEx	IECEx Certificate IEC 60079-0 Explosive atmospheres - General requirements IEC 60079-7 Equipment protection by type of protection "e" Certificate: IECEx EPS 12.0032X Temperature Code: T4 Type of Protection: ec
Class I Div 2	c SP us	CSA Certificate Power Supplies for Hazardous Location Applicable for Canada and US CSA Class: 5318-01 (Canada), 5318-81 (USA) Temperature Code: T4 Groups: A, B, C and D
Marine (DNV)	DNV DNV.COM/AF	DNV Certificate DNV Type approved product Certificate: TAA00002JT Temperature: Class B Humidity: Class B Vibration: Class C EMC: Class A Enclosure: Class A
Marine (ABS)	ABS	ABS Design Assessment Certificate ABS (American Bureau of Shipment) assessed product Certificate: 17-HG1599236-PDA
IEC 60068-2-60	Corrosion IEC 60068-2-60 Method 4 ✓	Manufacturer's Declaration (Online Document) Environmental Tests, Flowing Mixed Gas Corrosion Test Test Ke - Method 4 H2S: 10ppb NO2: 200ppb Cl2: 10ppb SO2: 200ppb Test Duration: 3 weeks, which simulates a service life of 10 years.

ISA-71.04 G3	Corrosion G3-ISA-71.04 ✓	Manufacturer's Declaration (Online Document) Airborne Contaminants Corrosion Test Severity Level: G3 Harsh H2S: 100ppb NOx: 1250ppb Cl2: 20ppb SO2: 300ppb Test Duration: 3 weeks, which simulates a service life of 10 years
VDMA 24364	LABS VDMA 24364-C1-L/W	Paint Wetting Impairment Substances Test (or LABS-Test) Tested for Zone 2 and test class C1 according to VDMA 24364-C1-L/W for solvents and water-based paints

14. REGULATORY PRODUCT COMPLIANCE

EU Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive - ATEX directive - RoHS directive
REACH Directive	REACH ✓	Manufacturer's Statement EU-Directive regarding the Registration, Evaluation, Authorization and Restriction of Chemicals
WEEE Directive		Manufacturer's Statement EU-Regulation on Waste Electrical and Electronic Equipment Registered in Germany as business to business (B2B) products.
EAC TR Registration	EAC	EAC Certificate EAC EurAsian Conformity - Registration Russia, Kazakhstan and Belarus 8504408200, 8504409000

15. PHYSICAL DIMENSIONS AND WEIGHT

Weight	140g / 0.31lb
DIN rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN rail depth must be added to the unit depth (91mm) to calculate the total required installation depth.
Installation clearances	See chapter 2

Fig. 15-1 **Front view**

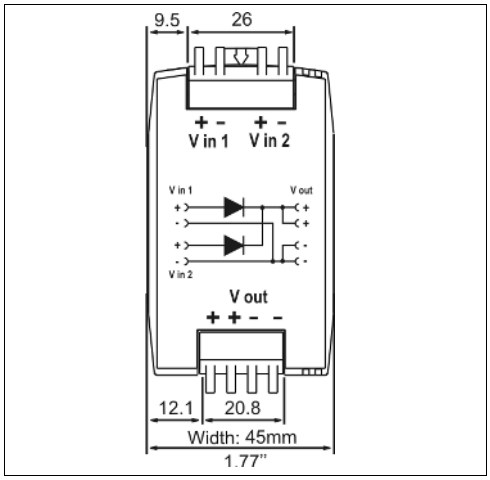
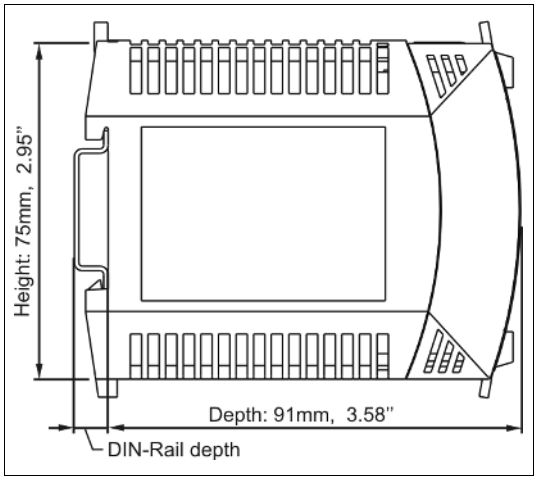


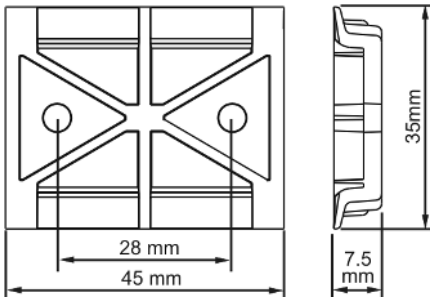
Fig. 15-2 **Side view**



16. ACCESSORIES

DIN rail bracket for wall or panel mount:

A suitable DIN rail bracket is available on request.



The picture of the power supply is for representation only

17. APPLICATION NOTES

17.1. RECOMMENDATIONS FOR REDUNDANCY

Recommendations for the configuration of redundant power systems:

- Use separate input fuses for each power supply.
- Use three-phase power supplies to gain functional safety if one phase fails.
- When single-phase power supplies are utilized connect them to different phases or mains circuits if possible.
- Set the power supply in "Parallel-Use" mode if this feature is available
- It is desirable to set the output voltages of all power supplies to the same value.

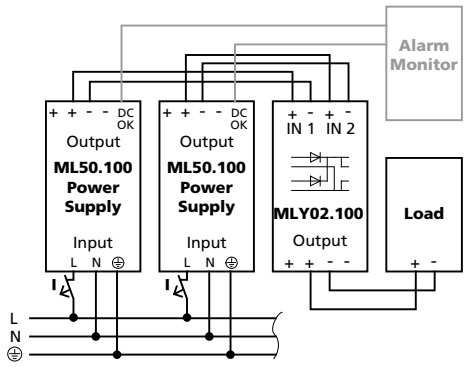
17.2. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

17.3. EXAMPLE: 1+1 REDUNDANCY

1+1 Redundancy up to 2.1A requires two ML50.100 power supplies (each 2.1A output current) and one MLY02.100 redundancy module.

Fig. 17-1 **Wiring diagram, 1+1 Redundancy, 2.1A output current**

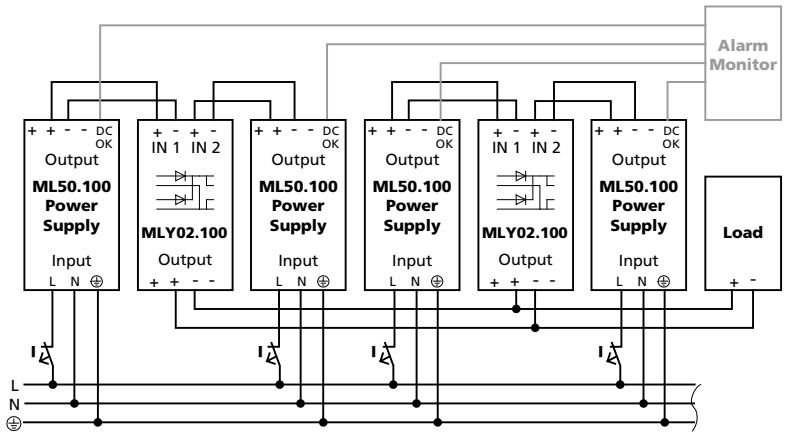


Note: Use separate mains systems for each power supply whenever it is possible

17.4. EXAMPLE: N+1 REDUNDANCY

N+1 Redundancy up to 6.3A requires four ML50.100 power supplies (each 2.1A output current) and two MLY02.100 redundancy modules.

Fig. 17-2 **Wiring diagram, N+1 Redundancy, 6.3A output current**



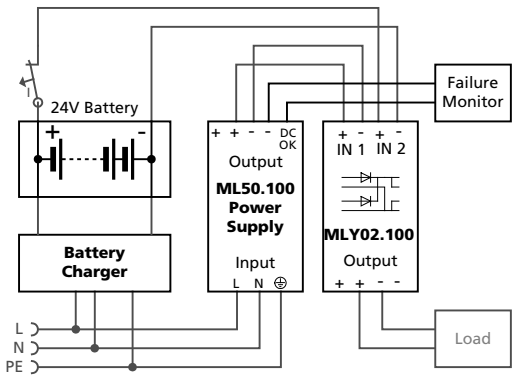
Note: Use separate mains systems for each power supply whenever it is possible

17.5. EXAMPLE: BATTERY BACK-UP

A battery back-up requires one power supply and one MLY02.100 redundancy module.

Please note:
Set output voltage of power supply to 26.5Vdc minimum to ensure, that the load current is delivered from the power supply and not from charger (battery). Use a fuse between battery and MLY02.100!

Fig. 17-3 **Wiring diagram, 10A Battery back-up**



17.6. MOUNTING ORIENTATIONS

Mounting orientations other than input terminals on the bottom and output on the top require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature.

Fig. 17-4
Mounting Orientation A
(Standard orientation)

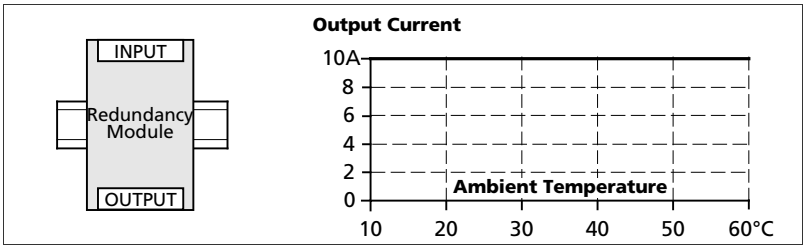


Fig. 17-5
Mounting Orientation B
(Upside down)

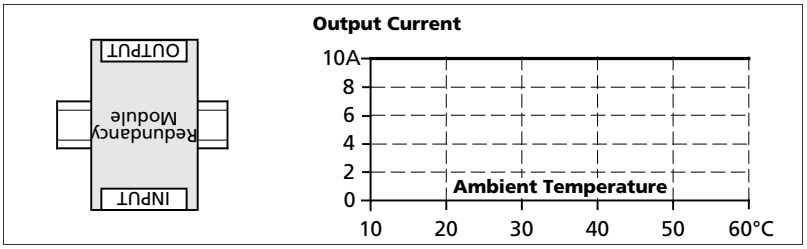


Fig. 17-6
Mounting Orientation C
(Table-top mounting)

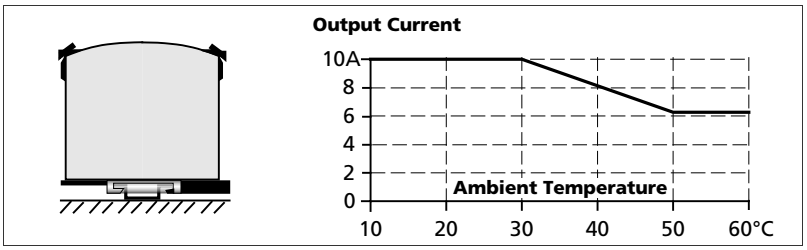


Fig. 17-7
Mounting Orientation D
(Horizontal cw)

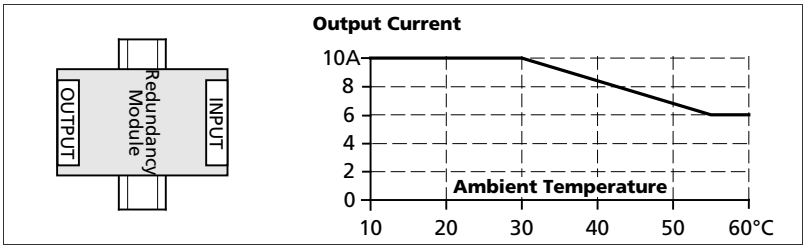


Fig. 17-8
Mounting Orientation E
(Horizontal ccw)